

Please amend the present application as follows:

**Specification**

The following is a copy of Applicant's specification that identifies language being added with underlining ("\_\_\_\_") and language being deleted with strikethrough ("—") or brackets ("[[ ]]"), as is applicable:

Page 5, line 27 through page 6, line 4.

In general, fuel cell membranes, micro-fuel cells, and methods of fabrication thereof are disclosed. Embodiments of the fuel cell membranes are made of silicon dioxide and/or a doped silicon dioxide and relatively thin and have comparable area resistivities as ~~thinner~~ thinner polymer membranes. The thinner the membrane, the easier it is for protons to move through it, thus increasing the amount of electrical current that can be generated. Meanwhile, the materials used to make the membranes are superior to currently used proton exchange membranes (PEMs) in preventing reactants from passing through the membrane, a common problem particularly in direct methanol fuel cells. In addition, the membranes can be fabricated using well-known micro-electronic fabrication techniques. In this regard, the membrane can be fabricated onto the micro-electronic structure to which the fuel cell is going to be used.

Page 8, lines 17 through 25.

FIG. 2 illustrates a cross-sectional view of a representative fuel cell membrane 10b. The fuel cell membrane 10b includes a composite membrane 18 and a catalyst layer 14a and 14b. The composite membrane 18 includes two membrane layers 12

and 16 (polymer layer 16). In another embodiment, the fuel cell membrane 10b can include three or more layers. One catalyst layer 44a 14b is disposed on the polymer layer 16, while the second catalyst layer 44b 14a is disposed on the membrane layer 12. The membrane layer 12 and the catalyst layers 14a and 14b are similar to those described in reference to FIG. 1. In addition, the fuel cell membrane 10b operates in a manner that is the same or similar to, that described above.

Page 9, lines 1 through 3.

In addition, in embodiments where the membrane layer 12 is silicon dioxide, this material is similar to the other insulators being used to fabricate the device, for example, when the membrane 42b 10b is used with a semiconductor device.

Page 9, line 26 through page 10, line 13.

The substrate 22 can be used in systems such as, but not limited to, microprocessor chips, microfluidic devices, sensors, analytical devices, and combinations thereof. Thus, the substrate 22 can be made of materials appropriate for the system under consideration (e.g., for printed wiring board, epoxy boards can be used). ~~Exemplar~~ Exemplary materials include, but are not limited to, glasses, silicon, silicon compounds, germanium, germanium compounds, gallium, gallium compounds, indium, indium compounds, other semiconductor materials and/or compounds, and combinations thereof. In addition, the substrate 12 can include non-semiconductor substrate materials, including any dielectric material, metals (e.g., copper and aluminum), or ceramics or organic materials found in printed wiring boards, for

example. Furthermore, the substrate 22 can include one or more components, such as the particular components used in certain systems described above.

The first porous catalyst layer 14a is disposed on the bottom side of the membrane ~~elosed~~ closest to the substrate 22. The second porous catalyst layer 14b is disposed on the top side of the membrane on the side opposite to the substrate 22. The micro-fuel cell 20a includes a first porous catalyst layer 14a and a second porous catalyst layer 14b, which form electrically conductive paths to the anode current collector 24 and the cathode current collector 26, respectively. The first porous catalyst layer 14a and the second porous catalyst layer 14b can include the same catalysts as those described above, and also have the same thickness and characteristics as those described above.

Page 13, lines 7 through 24.

The catalyst layer 43 is disposed on the substrate 12 within each of the channels 32a, 32b, and 32c. In another embodiment, the catalyst layer 42 34 can be disposed in less than all of the channels, which is determined by the micro-fuel cell configuration desired. The catalyst layer 43 34 can be a porous layer or can be a large surface area layer. The catalyst layer 43 34 can cover the entire portion of the substrate that would otherwise be exposed to the fuel in the channels 32a, 32b, and 32c, or cover a smaller area, as determined by the configuration desired. The catalyst layer 43 34 can include catalyst such as, but not limited to, platinum, platinum/ruthenium, nickel, palladium, alloys of each, and combinations thereof.

FIG. 3C illustrates a micro-fuel cell 20c having a membrane 28, a substrate 22, an anode current collector 24, a cathode current collector 26, a second catalyst layer 14b, a catalyst layer 43 34, and three channels 32a, 32b, and 32c. The membrane 28 can include the same chemical composition, dimensions, and characteristics, as that described for membrane 12 described above in reference to FIG. 1. The thickness of the membrane 28 is measured from the top of the channels 32a, 32b, and 32c.

The substrate 22, the anode current collector 24, the cathode current collector 26, the second catalyst layer 14b, the catalyst layer 43 34, and the three channels 32a, 32b, and 32c are similar to those described above in reference to FIGS. 3A and 3B.

Page 14, lines 17 through 25.

Now having described the structure 10 having micro-fuel cells 20a, 20b, 20c, and 20d in general, the following describes ~~exemplar~~ exemplary embodiments for fabricating the micro-fuel cell 20a, which could be extended to fabricate micro-fuel cells 20b, 20c, and 20d. It should be noted that for clarity, some portions of the fabrication process are not included in FIGS. 4A through 4H. As such, the following fabrication process is not intended to be an exhaustive list that includes all steps required for fabricating the micro-fuel cell 20a. In addition, the fabrication process is flexible because the process steps may be performed in a different order than the order illustrated in FIGS. 4A through 4H, or some steps may be performed simultaneously.

Page 15, lines 1 through 10.

FIG. 4A illustrates the substrate 22 having an anode current collector 24 disposed thereon. FIG. 4B illustrates the formation of the sacrificial material layer 42 on the substrate 22 and the anode current collector 24. The sacrificial polymer layer ~~22~~ 42 can be deposited onto the substrate ~~10~~ 22 using techniques such as, for example, spin coating, doctor-blading, sputtering, lamination, screen or stencil-printing, melt dispensing, CVD, MOCVD, and/or plasma-based deposition systems. In addition, a mask 38 is disposed on the sacrificial material layer 42 to remove portions of the sacrificial material layer 42 to expose the anode current collector 24. FIG. 4C illustrates the removal of portions of the sacrificial material layer 42 to form sacrificial portions 44a, 44b, and 44c.